Vegetation Mapping

Introduction

A critical information need within many National Parks is accurate and up to date information on vegetation composition and distribution. Shenandoah National Park has pressing management issues that rely on an accurate vegetation map including visitor safety, fire management, forest insect pest management, and rare species preservation.

The forests of Shenandoah have undergone dramatic changes in composition in the last several decades as the result of an aggressive fire suppression program, gypsy moth defoliation, hemlock wooly adelgid infestation, southern pine beetle infestation, ice storms, large wildland fires, and floods. Discrepancies in the accuracy of current vegetation map data, in addition to the massive changes that have occurred in the forests, served as motivating factors to pursue creation of a new park- wide vegetation map. Work to construct a new vegetation map began in 2001 and culminated in the delivery of the version 1.1 map in March 2005. [http://www.lsc.usgs.gov/gis/shen/shenveg/products.asp]. A second vegetation mapping effort was initiated in 2007 using an updated classification scheme and a greater number of field sampling plots. This effort will culminate in delivery of a version 2.0 map in March 2009.

Park staff recording data in Central Appalachian Dry Chestnut Oak – Northern Red Oak / Heath forest type.

Management Needs

Knowledge of vegetation composition and distribution is an integral part of many park activities including; planning, resources management and maintenance activities, natural and cultural resources inventory and monitoring, and coordination of scientific research projects. Interpretation of park vegetation, cultural landscapes and forest successional patterns is also based on accurate vegetation maps.

Existing errors in the 1987 forest cover type map, the lack of correlation between overstory composition and understory plant communities, and the number of large-scale changes in park vegetation have rendered it obsolete. Updated ecological association maps are critically needed to provide information for resource management planning and decision making, as a foundation for interpreting park resources, and for planning and developing inventory and monitoring efforts and research.

Entry Run Appalachian Montane Oak – Hickory Forest (Basic Type).

Current Procedures

The primary objective of the 2005 (version 1.1) and 2009 (version 2.0) vegetation maps is to classify the vegetation of the Park to the Association level of the U.S. National Vegetation Classification scheme using field collected data. A vegetation association as defined by this classification is equivalent to a vegetation community. It is composed of the large trees and shrubs present in an area as well as the small herbaceous and woody understory plants. The project began in 2001 with scientists from the U.S. Geological Survey – Biological Resources Division, Leetown Science Center (USGS) using terrain modeling techniques and existing information about environmental gradients to divide the park into ecological land units. Field sampling plot locations that represented all of the ecological land units were then generated for the entire park.

Field sample plots were visited by botanists from the Virginia Department of Conservation and Recreation (VA DCR) in 2002 and 2003 using their standard vegetation community assessment protocol (Virginia DCR, 2004). These methods typically involve using a 20 x 20 meter plot in which all plants are identified, and a suite of variables is collected to describe vegetation and environmental characteristics. The VA DCR then used cluster analysis

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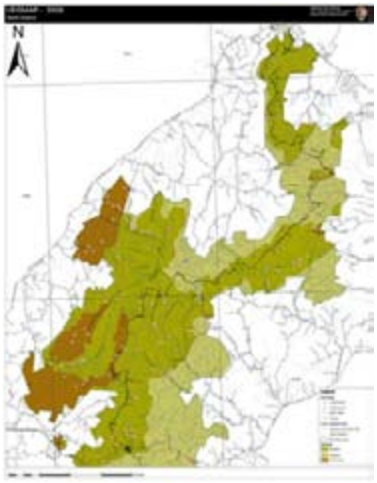
and ordination techniques on the data from 207 plots from this study combined with 103 plots previously completed to determine natural community groupings.

These community groups and the associated Global Positioning System data were then transferred to scientists at the USGS who integrated the community information into their terrain- based ecological gradient models. The addition of the community data was used to train the model to predict the distribution of plant communities based on environmental gradients such as exposure, moisture, rock type, and the vegetation spectral responses mapped from aerial photos and satellite imagery.



Example map covering the North District of the Park.

While the version 1.1 map was being created at USGS, VA DCR botanists were working to create a link between the vegetation communities that they had identified throughout the park, and the previously described communities in the National Vegetation Classification System. This process, termed a "crosswalk" was completed in early 2004, and was followed by the creation of a key to the vegetation communities mapped within the park.

The newly completed community type key was then used in 2004 for accuracy assessment field sampling (Stadelmann et al., 1994) by a new team of botanists from the VA DCR (2004). The accuracy assessment evaluated 224 points to determine how closely mapped units represented the actual vegetation on the ground. The results of the assessment were then used to determine how much confidence could be assigned to each map class for planning, monitoring, or other purposes.

A second accuracy assessment effort was completed in 2005 by an NPS technician and an intern to collect additional field data in areas underrepresented in the 2004 field sampling. Botanists from VA DCR also used previously collected data from other forest monitoring projects in the park to add additional remotely classified accuracy assessment points to the data set. After this additional analysis, 80% or more of the park was determined to be mapped at 80% or greater accuracy in the version 1.1 map.

The version 1.1 vegetation map was a statistical modeling-based research project, and not an air photo interpretation. As a result, some of the smaller, rarer classes did not meet the then current accuracy standards of the NPS vegetation mapping program. In 2007 the NPS National vegetation mapping program expressed interest in refining the version 1.1. map so that it would meet that program's required accuracy standards.

In response to this support, SHEN, USGS, and VA DCR began work on a version 2.0 map. A version 2.0 map was deemed necessary because enough time had passed since the creation of the version 1.1 map to render portions of the classification inaccurate. As a result, the classification schedule was updated and five new classes were added, and others were refined. All of the plot data from the previous accuracy assessment points was then combined with the original plot data and the models were completely re- run to generate the version 2.0 map.

The community type key underwent major revisions during the process of generating the version 2.0 map. The key was then used to conduct a third accuracy assessment in 2008. This accuracy assessment included about 800 field assessment points .

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Virginia Department of Conservation and Recreation (VA DCR) botanist collecting plot data for the new map in 2003.

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What We Have Learned

The vegetation mapping project successfully integrated the use of advanced gradient modeling techniques and multispectral and hyperspectral remote sensing imagery, with field vegetation sampling and community classification, to map the vegetation of Shenandoah National Park. The 2009 version 2.0 vegetation map will divide the park into 40 map classes, 38 of which are National Vegetation Classification System associations. These vegetation associations represent 24 examples of upland forests and woodlands, 1 alluvial/riparian forest, 6 non- alluvial wetlands, and 7 outcrop communities. Three of the communities mapped for the park were new to the National Vegetation Classification System and were described and ranked as part of the project. Eight of the communities are ranked as globally rare or uncommon, and two of the communities are endemic to Shenandoah National Park.

The final version 2.0 project report, digital map products, and imagery will be delivered to the park in March 2009. The new map is a noteworthy accomplishment and example of cooperation between agencies that will benefit park staff, cooperators, and the public for many years.

Crew walking through Hogback Mountain red oak forest type 8506 Northern Red Oak Forest.

References

Stadelmann, M., A. Curtis, R. Vaughn, M. Bailey, C. Convis, M. Goodchild, F. Davis, X. Li, K. Goodin, and D. Grossman. 1994. Accuracy Assessment Procedures: Final Draft. NBS/NPS Vegetation Mapping Program. U.S. Department of the Interior.

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An example of a Central Appalachian Rich Cove Forest in area of Franklin cliffs.